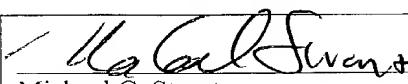


JC14 Rec'd PCT/PTO 03 JUL 2001

FORM PTO-1390 (REV 10-94)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		DOCKET #: 3397-98PUS
<b>TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371</b>				
				U.S. APPLICATION NO. (If known, see 37 CFR 1.6)
INTERNATIONAL APPLICATION NO <b>PCT/FI00/00008</b>		INTERNATIONAL FILING DATE <b>05 January 2000</b>		PRIORITY DATE CLAIMED <b>05 January 1999</b>
TITLE OF INVENTION <b>Method And Assembly For Supporting A Paper And Board Web In Finishing Equipment</b>				
APPLICANT(S) FOR DO/EO/US <b>Rauno RANTANEN; Juha LIPPONEN</b>				
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:				
<ol style="list-style-type: none"> <li>1. <input checked="" type="checkbox"/> This is a <b>FIRST</b> submission of items concerning a filing under 35 U.S.C. 371.</li> <li>2. <input type="checkbox"/> This is a <b>SECOND</b> or <b>SUBSEQUENT</b> submission of items concerning a filing under 35 U.S.C. 371.</li> <li>3. <input checked="" type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).</li> <li>4. <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.</li> <li>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2))             <ol style="list-style-type: none"> <li>a. <input checked="" type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau).</li> <li>b. <input type="checkbox"/> has been transmitted by the International Bureau.</li> <li>c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US)</li> </ol> </li> <li>6. <input type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)).</li> <li>7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))             <ol style="list-style-type: none"> <li>a. <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau).</li> <li>b. <input type="checkbox"/> have been transmitted by the International Bureau.</li> <li>c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.</li> <li>d. <input checked="" type="checkbox"/> have not been made and will not be made.</li> </ol> </li> <li>8. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</li> <li>9. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). <b>Unexecuted</b></li> <li>10. <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</li> </ol>				
<b>Items 11. to 16. Below concern other document(s) or information included:</b> <ol style="list-style-type: none"> <li>11. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.</li> <li>12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</li> <li>13. <input checked="" type="checkbox"/> A <b>FIRST</b> preliminary amendment.             <ol style="list-style-type: none"> <li><input checked="" type="checkbox"/> A Letter with Proposed Drawings Changes</li> </ol> </li> <li>14. <input type="checkbox"/> A substitute specification.</li> <li>15. <input type="checkbox"/> A change of power of attorney and/or address letter.</li> <li>16. <input checked="" type="checkbox"/> Other items or information (<i>specify</i>): PCT Publication, Int'l Preliminary Examination Report, PCT Request, Communication Stating Change in name of Applicant, and Demand</li> </ol>				

RECEIVED JUL 03 2001

U.S. APPLICATION NO. (If known, see 37 CFR 1.495)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
<b>09/869752</b>	<b>PCT/FI00/00008</b>	<b>3397-98PUS</b>
17. [x] The following fees are submitted:		
<b>Basic National Fee (37 CFR 1.492(a)(1)-(5)):</b>		
Search Report has been prepared by the EPO or JPO ..... <b>\$860.00</b>		
International preliminary examination fee paid to USPTO (37 CFR 1.482)..... <b>\$690.00</b>		
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2))..... <b>\$710.00</b>		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO ..... <b>\$1000.00</b>		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) ..... <b>\$100.00</b>		
<b>ENTER APPROPRIATE BASIC FEE AMOUNT =</b>		
\$ 860		
Surcharge of <b>\$130.00</b> for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).		
Claims	Number Filed	Number Extra
Total Claims	82 - 20 =	62
Independent Claims	2 - 3 =	
Multiple dependent claim(s) (if applicable)		+ <b>\$270.00</b>
<b>TOTAL OF ABOVE CALCULATIONS =</b>		
\$ 1976		
Reduction of $\frac{1}{2}$ for filing by small entity, if applicable.		
<b>SUBTOTAL =</b>		
\$		
Processing fee of <b>\$130.00</b> for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f)).		
<b>TOTAL NATIONAL FEE =</b>		
\$ 1976		
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by the appropriate cover sheet (37 CFR 3.28, 3.31). <b>\$40.00</b> per property +		
<b>TOTAL FEES ENCLOSED</b>		
\$ 1976		
		Amount to be refunded:
		charged:
<p>a. [x] One check in the amount of <u>\$ 1976</u> to cover the above fee is enclosed.  b. [ ] Please charge my Deposit Account No. <u>03-2412</u> in the amount of \$_____ to cover the above fees. A duplicate copy of this sheet is enclosed.  c. [x] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. <u>03-2412</u>. A duplicate copy of this sheet is enclosed.</p>		
<p><b>NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.</b></p>		
SEND ALL CORRESPONDENCE TO <u>Michael C. Stuart</u> Cohen, Pontani, Lieberman & Pavane 551 Fifth Avenue, Suite 1210 New York, New York 10176		 <u>Michael C. Stuart</u> <u>Registration Number: 35,698</u> <u>Tel: (212) 687-2770</u>

39PR75

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1

**Method and assembly for supporting a paper and board web  
in finishing equipment**

The invention relates to a method according to the pre-  
5 amble of claim 1 for supporting and passing webs such as  
paper and board webs in a contacting manner in a  
paper/board machine in which the base web forming section  
is immediately followed by web finishing devices for  
immediate treatment of a web leaving the base web forming  
10 section.

The invention also concerns an assembly suited for imple-  
menting said method.

15 With the increasing demands on higher web speeds and  
quality, well-behaved supporting and drying of a running  
web are becoming increasingly important in paper and  
board manufacture. Therefore, it is desirable to pass the  
web in a continuously or at least partly supported manner  
20 over a maximally long total distance of its travel in the  
web finishing sections. The technique used for web  
support also affects the drying process of the web. As  
web breaks occur more easily in a wet web than in a dry  
web, unsupported passages of the wet web over the  
25 distance from one support member to the next, before the  
wetted web is dried, represent potential points of web  
breaks. If the web can be supported in a contacting  
manner as long as the web is wet, the number of web  
breaks can be reduced. Simultaneously, the coating of the  
30 web may also be carried out at a higher moisture content  
and thus in a state of weaker tensional strength than has  
been possible in the prior art. As a result of processing  
the web at said higher moisture content, substantial  
savings can be attained in regard to both the overall  
35 energy consumption and investment costs of the dryer  
equipment. Further, as the specific drying capacity re-  
quired in the different process steps for obtaining

sufficient strength qualities of the web is not set any more, the moisture content of the web can be kept optimal with respect to the desired end product qualities throughout the manufacturing process.

5

In US Pat. No. 5,547,509 is described an apparatus for supporting a paper web during the application step when the web is passed through the coating and doctoring installation. In this embodiment, the coating applicator 10 may be, e.g., an application roll and the web is passed onto a support belt before it enters the nip of the applicator and, after application, is passed in a supported manner to the dryers. The function of the support belt is to reduce the number of web breaks in application 15 and doctoring as well as along the web passage from the doctor blade to the dryers. The dryers are of the non-contacting type and the web is supported over its passage between the dryers by means of small-diameter support rolls. The supported portion of web travel covers the 20 applicators only. Before entering the applicator and during drying, the web runs unsupported. Furthermore, as the application takes place using an applicator roll, the entry of the web to the applicator roll is very complicated, because the applicator roll (kissing roll) of a 25 roll applicator must be arranged to rotate in a coating mix pan, which necessarily requires the applicator roll to be the lower roll in the roll nip and, as a result, the coated side of the web to be the underside of the web entering the applicator nip. Obviously, passing the web 30 to one applicator is simple along a straight path, but as the web is conventionally coated on both sides, reversing the web travel for coating the opposed side requires a complicated guide roll set in which the web cannot be supported by any practicable means using a support wire 35 or belt.

In German patent publication no. 44 20242 is described an

application method in which the web is coated in a film-transfer coater and then passed over the backing roll to a drying cylinder. Operating in conjunction with the backing roll, there is arranged an unrestrained type of 5 dryer and from the backing roll the web is passed to a wire-supported dryer cylinder. While the wire in this embodiment is supportedly passed through the dryer cylinder section, the most critical passage with respect to web breakages, that is, the web travel within the area of 10 the applicator and the first dryer unit, is passed only supported at the support rolls. Since the web has no continuous support when it is wet and hence has the lowest strength, this kind of web supporting offers no substantial contribution to web runnability and lesser 15 number of web breaks.

It is an object of the present invention to provide a method for implementing a fully-supported travel of a web running on a wire or belt through the coating applicator 20 and also, at least partially supportedly, during subsequent drying.

The goal of the invention is achieved by passing the web to a coater station or other web treatment device in 25 which the web will be wetted and, further, to at least the first dryer located next downstream to the coater in a continuously contactingly supported manner.

According to a preferred embodiment of the invention, the 30 web is passed in a continuously contactingly supported manner from a dryer preceding a coater to a dryer located next to the coater in the downstream direction of web travel.

35 According to an embodiment of the invention, the web is passed from a dryer preceding the coater to a dryer located next to a coater in the web downstream travel

direction with the help of a single continuous support means.

According to an embodiment of the invention, the web is  
5 passed to at least one coater with the help of the support means of the upstream preceding web treatment device.

According to the most preferred embodiment of the invention,  
10 the web is passed to a coater from the upstream preceding web treatment device in a supported manner and only partially dried.

More specifically, the method according to the invention  
15 is characterized by what is stated in the characterizing part of claim 1.

Further, the assembly according to the invention is  
20 characterized by what is stated in the characterizing part of claim 32.

The invention offers significant benefits.

Continuous belt or wire support can effectively reduce  
25 the number of web breaks occurring in the manufacture of paper grades having a low basis weight. Additionally, the support embodiment according to the present invention based on belt-supported web travel permits the web to be passed to a coater only partially dried, because this arrangement eliminates the risk of breaks in a wet web. In this context, the term partially dried web must be understood to refer to a web having a moisture content essentially higher than that of the finished end product. In this manner, the drying process of the base web and  
35 its coating in the manufacture of a paper/board grade can be optimized so as to achieve a maximally high quality of the finished end product. As a result, the coating pro-

cess can be carried out at the optimum moisture content with respect to the desired qualities of the coated paper/board product, specific energy consumption and the drying requirements of the base web and its coating, as 5 well as with respect to the investment cost of drying capacity and the overall efficiency of the manufacturing process. By contrast, in prior-art embodiments it has been mandatory to pass the base web in a rather dry state into the coater in order to avoid web breaks. In practice, 10 this has required the moisture content of the base web leaving the papermaking machine to be substantially equal to that of the finished end product.

15 In the following the invention will be examined in greater detail with the help of the appended drawings in which

20 Fig. 1 shows diagrammatically a first coater/dryer arrangement according to the invention;

Fig. 2 shows diagrammatically a second coater/dryer arrangement according to the invention; and

25 Fig. 3 shows a preferred coater arrangement utilizing an embodiment according to the invention.

It must be noted that the term coater in the context of the present invention is used in a broad sense including also size presses and other web treatment equipment in 30 which a material is applied to the surface of a web in a manner causing an increase of moisture content in the web.

35 Referring to Fig. 1, a web 1 in the arrangement illustrated therein is passed to the applicator section of a coater directly from a forming section supported by a dryer wire 2 of the papermaking machine. Obviously, the

same arrangement may also be used in conjunction with a board making machine. At the end of the dryer section of the papermaking machine, the web 1 passes supported by a wire 2 over dryer cylinders 3, whereby the moisture 5 content of the web 1 exiting from the papermaking machine is controlled to a desired value at these cylinders. When leaving these last dryer cylinders 3, the web is passed supported by the wire 2 of the dryer section of the papermaking machine to a first applicator station 4. The 10 applicator is a film-transfer coater in which the coating mix is first applied by an applicator apparatus 6 onto the surface of a film-transfer roll 5 and then in a nip formed between the film-transfer roll 5 and a backing roll 7 to the surface of the web being coated. The web 1 15 and the dryer wire 2 pass over the backing roll 7.

Operating in conjunction with the backing roll 7, there is disposed a noncontacting dryer 8 denoted by arrows pointed toward the web in the diagram. The noncontacting 20 dryer can be implemented as an air or steam dryer, IR dryer, microwave dryer or other suitable type of noncontacting dryer. Most advantageously, the noncontacting dryer 8 is an impingement air dryer adapted to operate with air jets directed partially against the backing 25 roll 7 of the film-transfer coater and partially against the dryer wire 2 over the length of the continuous wire supporting the web after leaving the backing roll. This arrangement provides a long drying travel in a noncontacting manner, simultaneously keeping the overall length 30 of the wire loop and the travel length of the wire as short as possible. Still supported by the drying wire 2, the wire is passed from the backing roll 7 in the downstream direction to a first postdryer cylinder 9, where the coated side of the web 1 wraps the dryer cylinder 9 when pressed by the wire 2 against the surface of 35 the cylinder 9. The surface of the dryer cylinder 9 may be surfaced with an antistick coating such as Teflon®.

(PTFE) or, more advantageously, a pressurized dryer cylinder is used at which air or superheated steam is blown from within the cylinder against the web thus lowering the surface pressure of the web against the cylinder or even forcing the web off from the cylinder surface into a noncontacting floating position. The cylinder 9 in the present context must be understood to refer in a general sense to any part of a dryer cylinder group. Obviously, different types of dryer cylinder elements can be used in a dryer section in lieu of the one illustrated herein when varied embodiments of the invention are to be implemented.

At this stage, the web need not necessarily be dried to its final moisture content. The dryer wire 2 of the papermaking machine is passed from the first postdryer cylinder 9 over a guide roll to the return leg of the wire back toward the direction of the papermaking machine.

The web 1 being processed now leaves the dryer wire 2 and passes onto a second wire 11 that runs over a guide roll 12 so as to transfer and support the web in the following web treatment device. Over the distance from the post-dryer cylinder 9 to the guide roll 12 of the second wire 11, the web 1 travels without support by a wire. However, the web can be passed over such a short distance unsupportedly inasmuch the web is not subjected to any stressing treatment and the web is relatively dry, whereby it is most tolerant to a possible tensional stress due to variations in web draw. This open passage of web travel can be utilized for measuring various qualities of the paper using a measurement beam sensing the sheet from both sides. However, it is also possible to pass the web if so required directly in a supported manner from the dryer wire 2 to the next dryer wire 11 using any conventional supporting means.

The second wire 11 passes the web 1 to a dryer cylinder 13, where the web travels in a nip between the dryer cylinder 13 and the wire having the coated side of the web facing the wire 11, which requires the sheet-facing side of the wire to be sufficiently smooth. Alternatively, the cylinder 11 may be any cylinder of a dryer section or a web lead roll or draw roll or a set of such rolls. Supported web travel permits the drying process of the sheet to be controlled during the different treatment steps of the web 1 so that the drying and wetting of the base sheet during application takes place in an optimal manner and the penetration of water from the coating mix into the base sheet can be controlled.

From the predryer cylinder 13, the web is passed to a backing roll 7 of a second coater station 14. At this stage, the web 1 and the second wire 11 travel so that the wire passes through the nip between the web and the backing roll 7 and, simultaneously, the applicator roll 5 rests against the web 1, whereby it applies a coat layer to the uncoated side of the web 1. Next, the web is passed supported by the second wire 11 via a noncontacting dryer section to the first postdryer cylinder 9, where the coated side of the web wraps the cylinder surface. In this web treatment step, the contacting dryer is an inverted dryer cylinder group. With the help of the inverted group, the web can be passed from the upper, leaving group to the lower, receiving group and vice versa as is the case when the supported and treated sides of the web are to be reversed, e.g., for coating the opposed side of the web. In this embodiment, also the predryer cylinder 13 is disposed in a position corresponding to that of the inverted roll group, because the cylinder is the first dryer member to receive the web.

In Fig. 2 is shown an alternative embodiment of the

invention in which the web 1 leaving, e.g., the second coater station and its inverted roll group is passed to the next coating step and, simultaneously, the supported side of the web 1 is reversed, whereby the web is passed 5 to run on a third wire 15. It must be noted that the web may as well be received from the wire of the papermaking machine. In the case that the wire is received from the first coater station, its both sides are already coated once, whereby the embodiment of Fig. 2 is used for 10 applying a second coat layer. Therefore, the new layer of coating is applied in this embodiment to the first side of the web in a manner slightly different from that described above for the preceding coater stations 4, 14. Herein, the applicator roll 16 is a large-diameter 15 cylinder having dimensions approximately equal to those of the dryer cylinders and the web wraps this cylinder 16 under the loading pressure imposed by said third wire 15. The coating is metered on the applicator roll 16 by means of an applicator apparatus 6 located under the applicator roll, whereby the coat can be transferred to the web 1 20 during the long dwell time of the web on the cylinder surface. The application pressure is imposed by means of said third wire 15 and if so required, the loading pressure may be increased with the help of a press roll 17 or 25 a sliding shoe pressing the wire 15 and the underlying web 1 against the applicator roll 16. From the applicator roll 16, the web 1 passes about a guide roll 18 having a noncontacting dryer 8 adapted to cooperate therewith. Next to the noncontacting dryer is disposed a postdryer 30 cylinder 9, wherefrom web travels over an unsupported passage to a fourth wire 18 and a fourth coater station 19. Herein, the path and coating operations of the web are equivalent to those of the first coating step carried out on the second side of the web. After the 35 application of the second coat layer to the second side of the web, the web is dried to its final moisture content and passed to an winder or, alternatively, the

web can be passed to a calender, whereby the moisture content of the web must be controlled to a proper level for calendering.

5 To remove excess moisture from the web, the dryer cylinders may be complemented with air-impingement or suction hoods 20. The web support can be implemented with the help of various kinds of belt or wire elements. A basic requirement is that the structure and material of the 10 elastic, continuous support element is compatible with the handling of the product being manufactured. In board manufacture, the wire may even have a coarse texture, while paper grades of high basis weight require a fine-weave wire and a low-weight paper grade must be supported 15 using an extremely fine-weave wire, support belt or even a support band of substantially nonpermeable, smooth material. In principle, the lower the basis weight of the product the smoother the support element must be in order to avoid marks in the supported web. Respectively, the 20 film-transfer roll of the applicator apparatus should preferably be of a soft-surfaced type, advantageously having a hardness in the range of 20 - 100 P&J when the film-transfer technique is being used for coating application.

25 In Fig. 3 is shown an embodiment according to the invention for a fully-supported web travel through a film-transfer coater. In this arrangement, both sides of the web 1 are treated at the same coater station. This 30 embodiment is particularly suited to surface sizing, wherein the surface smoothness of support elements and cylinders are not decisive to the surface quality as in the actual coating application. The arrangement is fully free from unsupported web passages and the web is supported throughout the web treatment process by a roll or 35 a support element. Supported by the papermaking machine wire 2, the web enters the film-transfer coater from,

e.g., the dryer cylinder group of the papermaking machine over dryer cylinders 3 and turning rolls. After the last dryer cylinder, the wire 2 is arranged to pass around a cross-over roll 21. The cross-over roll 21 is wrapped by 5 a cross-over support belt or wire 22 that also runs around a turning roll 23, whereby the web 1 is picked up at the cross-over roll between the papermaking machine wire 2 and the cross-over support wire 22. At the separation point of the wires 2 and 22, the cross-over support 10 wire has been arranged to pick up the web 2 by means of a suction box adapted behind the cross-over support wire 22 or by selecting the wire materials and weave smoothnesses properly or by using a smooth transfer belt to which a dry web adheres with the help of static electricity or a 15 wet web adheres due to adhesion forces which are stronger toward a smooth-surfaced belt than a permeable wire. The use of a smooth-surfaced belt is particularly advantageous in the above-described embodiment in which the web will not be dried to its final moisture content prior to 20 its surface sizing or coating application. Furthermore, this arrangement requires less space than constructions performing web transfer from one support wire to another by means of a suction box.

25 From the support wire 2, the web is transferred to a first applicator roll 24 having a first applicator apparatus 26 adapted to cooperate therewith so as to apply a surface size, coating or other web treatment agent to the surface of the roll 24. Since the outer perimeter of the 30 applicator roll 26 is wet due to the treatment agent metered thereon, the web 1 meeting the roll 24 readily adheres to the roll surface. Next, the web adhering to the surface of the first applicator roll 24 passes into the nip formed between the applicator rolls 24, 25, wherein 35 it is transferred to wrap the surface of the second applicator roll 25. A second applicator apparatus 27 is used to apply the web treatment agent to the surface of

the second applicator roll. As the web 1 has been wrapping the perimeter of the first applicator roll by half a turn, it tends to continue its adherence to the roll surface. Hence, the surface properties of the first and 5 the second applicator roll must be selected so that the web 1 has a greater preference to leave the nip by adhering to the surface of the second applicator roll 25. As the surfaces of both applicator rolls are wetted by the web treatment agent, the web separates more readily 10 if the supporting surface has a coarser structure provided by a more hydrophilic material or, alternatively, the surface is made harder. Toward this end, the surface of the second applicator roll may be surfaced with a smooth, hydrophobic coating such as Teflon® (PTFE), 15 whereby the surface of the first applicator roll is surfaced with another material of a coarser structure, such as rubber.

Over the surface of the second applicator roll 25 is 20 adapted to run a dryer group wire 11 that is passed to the applicator roll over a turning roll 12. At this stage, an air-permeable wire or felt is advantageously used as the web support element, since this arrangement permits the web 1 to be easily transferred by means a 25 suction box 28 adapted to the point where the wire 12 leaves the second applicator roll 25 to adhere to the wire 11. Next, the web passes supported by the wire 11 to a conventional dryer cylinder group, where the wire 11 presses the web against the surface of the dryer cylinders. In surface sizing, the web 1 can be passed directly 30 to the dryer cylinders 3, and both sides of the web can be treated in the above-described manner simultaneously.

The method taught above for transferring a web from one 35 support element to another by virtue of utilizing the differences in the adherence properties of the support elements may be advantageously employed in the arrange-

ments illustrated in Figs. 1 and 2, as well as any other embodiments covered by the scope and spirit of the invention.

5 In addition to those described above, the present invention may have alternative embodiments.

Web moisture content in the various web treatment steps can be adjusted optimal to achieve the desired end result  
10 of the coating application or web treatment process, because there is no more any need to dry the web between the treatment steps below the optimum moisture content of the process in order to achieve better runnability over the unsupported passages. As a fully supported web can be  
15 handled even when wet and unsupported passages are eliminated from the travel of the wet web, the web needs drying only so much as is necessary to pass the web supportedly through the next application step and to achieve, e.g., an optimal coat surface quality, coat  
20 weight or minimized specific energy consumption in drying. In this manner, the web treatment steps can be carried out at their optimal points of the papermaking process in regard to web moisture content, e.g., to manufacture a given paper grade, to eliminate web breakage  
25 for some paper grade or implement an energy management system of the process or to control some other kind of process variable.

Web support can be implemented using a continuous movable element which may be, e.g., a metal, polymer, glass fiber or carbon fiber belt, wire, felt or web or band. As discussed above, the surface properties of support element have a decisive role in the transfer of the web from one support element to another, which means that the permeability properties of the support element surfaces must be optimized so as to eliminate all separate web tail threading or support means from the web transfer and

threading system. The selection of the suitable support element type is also dependent on the dryer equipment used, whereby air-impingement and suction dryers conventionally require a gas-permeable support element for 5 proper function, while infrared dryers and the like need the support element to be only resistant to the heat load imposed by the dryer.

The web support method according to the invention may 10 also be used in combination with noncontacting web support arrangements so that the web is passed supported by air jets to a section utilizing the support system according to the invention or, respectively, is passed from the process line section utilizing the support 15 system according to the invention to the next downstream located web treatment section, where the web is guided by means of an air-jet support system. The number of dryer cylinders before and after the web treatment section discussed herein may be varied as needed and the desired 20 sections of the web processing line may be implemented using two-wire support in which the web is supported from both sides.

The web support elements may be grouped in many different 25 fashions. In addition to those described above, the web may be guided so that a single continuous support element is used to pass the web from the first web treatment device all the way down to the next web treatment device. The application nip or area may be formed by pressing the 30 support belt either directly against the web by means of the belt-tensioning force or by augmenting the loading pressure with a separate press roll or sliding shoe. When the web is passed from one support element to another, it can be passed via wire/web spreading means.

transfer coater mention is made on the surface of an applicator roll, the coating film may as well be applied via a single belt in single-sided coating application and, in two-sided coating application, via two belts or 5 one belt combined with an applicator roll. Accordingly, the invention is not limited to the use unrestrained drying, but instead, the web may be passed supported according to the invention directly to a dryer cylinder in a contacting manner unless other technical details of 10 the process are contradictory to this.

Web support can be implemented over the distance from a hood-covered coater to a downstream located dryer so that the web postprocessing steps or the runnability and/or 15 environmental aspects of the papermaking machine are taken into account with regard to good operability, control and maintenance. The hood can be divided into compartments, whereby the above-mentioned requirements are easier to meet by compartment. Web drying may also be 20 carried out using two-sided drying. Herein, a metallic or heat-resistant polymer material belt can be used.

The methods according to the invention may be complemented with coat weight measurement means when the web 25 travels supported on a belt or wire. Obviously, this excludes the use of two-sidedly located measurement equipment. A suitable gaging technique of, e.g., solids in the base sheet and coat weight for  $\text{CaCO}_3$ -based pigments is the x-ray fluorescence method. The x-ray 30 fluorescence technique may be complemented with any conventional sheet basis weight and moisture content measurement means, whereby a plurality of sheet quality factors can be computed from the measurement data.

**What is claimed is:**

1. Method for supporting a web (1) during the post-processing of a web of paper or board, the method comprising the steps of:

5 - passing the web from a preceding section to at least one next downstream located web treatment section (4) wherein to at least one side of the web (1) is applied a treatment agent causing wetting of said side of said web, and

10 - passing the web (1) exiting said web treatment section to at least one dryer apparatus (8),

15 characterized in that

20 - supporting the web (1) contactingly in a continuous and unbroken manner at least from said web treatment section (4) to said dryer (8).

2. Method according to claim 1, characterized by comprising the steps of

25 - drying the web (1) with at least one drying apparatus (3) prior to passing the web to said web treatment section (4), and

30 - contactingly supporting the web in a continuous and unbroken manner at least from said drying apparatus (3) preceding said web treatment section (4) to said dryer apparatus (8) located downstream next to said web treatment section.

35 3. Method according to claim 2, characterized in that the web (1) is supported by means of a dryer wire (2) of a paper- or board making machine.

4. Method according to claim 2 or 3, characterized in that the web is passed supported by a continuous support element (2) at least from a drying apparatus (3) preceding said web treatment section (4) to the drying apparatus (8) located downstream next to said web treatment section.

5. Method according to claim 2, characterized in that the web (1) is passed to at least one downstream located web treatment section (4) supported by the continuous support element of the upstream preceding web treatment section.

10

6. Method according to claim 1, characterized in that the web (1) is passed supportedly and only partially dried from an upstream preceding web treatment section to the next downstream located web treatment section.

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20

7. Method according to claim 4, characterized in that the web (1) is supported by one and the same support element (2) through said web treatment section (4) and during the entire web travel through the next downstream located drying apparatus (8).

25

8. Method according to claim 1, characterized in that the web (1) is supportedly passed from the upstream preceding, web-wetting treatment section to the next downstream located web treatment section and the web is dried so that at least a portion of the moisture content of the web is evaporated.

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9. Method according to claim 6, characterized in that the web (1) is passed to said web treatment section in a condition optimized with respect to the requirements of the paper grade being manufactured, the

investment costs, the frequency of web breakages, the overall energy consumption of the process, desired paper quality or the like target variable.

5 10. Method according to claim 1, characterized in that the web is supported by means of a support element against a member of the web treatment apparatus, advantageously a film-transfer roll or blade coater, that serves to apply a web-wetting agent to the  
10 surface of the web.

11. Method according to claim 1, characterized in that the web is dried by a microwave dryer, air-impingement dryer, contacting dryer, suction dryer or  
15 the like dryer means, wherein the web is supported by a member of a material suitable for resisting the impact of said drying apparatus.

12. Method according to claim 1 or 11, characterized in that the web is supported by means of a belt or surfaced belt or fabric that is impermeable to moisture.  
20

13. Method according to claim 1 or 11, characterized in that the web is supported by means of a wire, fabric, porous felt or porous or perforated belt that is permeable or absorbent to a liquid or gaseous  
25 medium.

30 14. Method according to claim 1, characterized in that at least one surface of the web is coated with a coating which is transferred with the help of a movable member passing through an application nip or area.  
35

15. Method according to claim 14, characterized in that said application nip or area is formed

by a loading element such as a roll, belt or sliding shoe.

16. Method according to claim 1, characterized in that the web is supported in the first web treatment section by air-jet support means, after which the web is passed onto a contacting support element for spreading the web, subjecting the same to measurement of process qualities or supportingly passing the web to subsequent web treatment sections.

17. Method according to claim 1, characterized in that the web is supported by a plurality of successive support elements and the web (1) is transferred supportedly or guided by web guidance means (10) from one support element (2) to the next support element (11) in the succession.

18. Method according to claim 1 or 17, characterized in that the web is passed from one support element to the next via web spreading or tension-controlling means.

19. Method according to claim 1 or 15, characterized in that the web (1) is pressed against the surface of at least one roll serving to form a nip and apply a coating.

20. Method according to claim 1 or 15, characterized in that the web (1) is pressed against the surface of at least one sliding shoe element serving to form a nip and allowing a coat-applying planar element to slide thereon.

35 21. Method according to claim 1, characterized in that a first side of the web is supported by a movable continuous support element, while a coating is

applied to the second side of the web using, e.g., a spray-coating method, a jet-coating method, a blade/rod coater or an applicator roll coater.

5 22. Method according to claim 1 or 22, characterized in that the web is adhered to the support element by means of air impingement or suction.

10 23. Method according to claim 1, 2, 4, 5, 6 or 8, characterized by comprising the steps of

15 - passing the web to a predryer cylinder group comprising at least one dryer cylinder and pressing the web against the cylinder by means of a single-wire support arrangement,

20 - supportedly passing the web to a treatment of the first side of the web, said web treatment comprising at least the application of a coating and the spreading/tensioning of the web, and

25 - passing the web to a like treatment of its second side and then by means of a single-wire support arrangement to a postdryer group.

24. Method according to claim 1, characterized in that the web is supported by a succession of support elements (2, 22, 24, 25, 11) whose surface qualities are selected so that the adherence of the web at the cross-over point of said support elements is stronger to the downstream next, receiving support element than to the upstream preceding, delivering support element.

35 25. Method according to claim 24, characterized in that the web is supported by elements in which the surface of the delivering support element is

more hydrophilic than the surface of the receiving support element.

26. Method according to claim 24, characterized in that the web is supported by elements in which the surface of the delivering support element is softer than the surface of the receiving support element.

27. Method according to claim 24, characterized in that the web is supported by elements in which the surface of the delivering support element (24) has a coarser texture than the surface of the receiving support element (25).

28. Method according to claim 24, 25, 26 or 27, in which method the web treatment device is a film-transfer coater, characterized by comprising the steps of

- passing the web (1) transferred on the support wire (2) of the dryer to a first support element (22),

- passing the web (1) from said first support element (22) onto the surface of a first film-transfer applicator roll (24),

- passing the web supported by the outer circumferential surface of said first film-transfer applicator roll (24) onto a second film-transfer applicator roll (25), and

- passing the web supported by the outer circumferential surface of said second film-transfer applicator roll (25) onto a next downstream located contacting support element (11).

29. Method according to claim 1 or 24, characterized

terized in that the web is supported by means of a movable element that can be, e.g., a metal, polymer, glass fiber or carbon fiber belt, wire, felt or web or band.

5

30. Method according to claim 1, 15 or 24, characterized in that the web is supported in the film-transfer coater by means of a support belt that serves to transfer a web treatment agent to the surface 10 of the web.

31. Assembly for supportedly guiding a web (1) during the postprocessing of a web of paper or board, said assembly comprising

15

- at least one web treatment device (4),
- at least one device (3) preceding said web treatment device,

20

- elements (2) for passing the web (1) from said preceding device (3) to at least one next downstream located web treatment device (4) suited for applying to at least one surface of the web (1) a treatment agent that wets the web, and
- elements for passing the web (1) to at least one dryer (8) following said web treatment device,

30       characterized by

- at least one support element (2) for passing the web (1) in a continuous and unbroken manner at least from said web treatment device to said next downstream located dryer.

32. Assembly according to claim 31, characterized -

i z e d b y

- at least one dryer (3) for drying the web prior to passing the web to said web treatment device (4), and

5

- a support element for contactingly supporting the web (1) in a continuous and unbroken manner at least from said dryer (3) preceding said web treatment device (4) to said dryer (8) located downstream next to said web treatment device.

10

33. Assembly according to claim 31, c h a r a c t e r - i z e d in that said element for passing the web (1) is a dryer wire (2) of a paper or boardmaking machine.

15

34. Assembly according to claim 31, c h a r a c t e r - i z e d by a single continuous support element (2) being used for passing the web in a supported manner at least from said dryer (3) preceding said web treatment device (4) to said dryer (8) located downstream next to said web treatment device.

25

35. Assembly according to claim 31, c h a r a c t e r - i z e d by a single continuous support element being used for passing the web (1) to at least one next downstream web treatment device from an upstream preceding web treatment device.

30

36. Assembly according to claim 35, c h a r a c t e r - i z e d by one and the same support element (2) being used for supporting the web (1) through said web treatment device (4) and during the entire web travel through the next downstream located dryer (8).

35

37. Assembly according to claim 31, c h a r a c t e r - i z e d by having at least one support element adapted to support the web (1) so as press the web against a

member of the web treatment section, advantageously a film-transfer roll or blade coater, that serves to apply a web-wetting agent to the surface of the web.

5 38. Assembly according to claim 31, characterized by at least one microwave dryer, air-impingement dryer, contacting dryer, suction dryer or the like dryer apparatus, wherein the web is supported by a member of a material suitable for resisting the impact of said dryer.

10 39. Assembly according to claim 31 or 38, characterized in that said support element is a belt or surfaced belt/fabric that is impermeable to moisture.

15 40. Assembly according to claim 31 or 38, characterized in that said support member is a fabric, porous felt or porous/perforated belt that is permeable or absorbent to a liquid or gaseous medium.

20 41. Assembly according to claim 31, characterized by at least one movable element capable of defining at least one application nip or area in which nip or area at least one surface of the web is coated with a coating transferred with the help of said movable member passing through said application nip or area.

25 42. Assembly according to claim 41, characterized by having said application nip or area defined with the help of a loading element such as a roll, belt or sliding shoe.

30 43. Assembly according to claim 31, characterized by a plurality of successive support elements serving to support the web and to transfer the web (1) supportedly or guided by web guidance means (10) from one support element (2) to the next support element (11) in the succession.

44. Assembly according to claim 31, characterized -  
5 i z e d by means for supposedly pressing a first side  
of the web against a movable continuous support element  
and means for applying a coating to the second side of  
the web using, e.g., a spray-coating method, a jet-  
coating method, a blade/rod coater or an applicator roll  
coater.

10 45. Assembly according to claim 31 or 44, characterized -  
t e r i z e d by air-impingement or suction means for  
adhering the web to the support element.

15 46. Assembly according to claim 31, characterized -  
i z e d in that the surface of the support element is  
patterned with a desired surface texture serving to make  
a desired surface or base coating pattern on the web side  
to be treated.

20 47. Assembly according to claim 31, characterized -  
i z e d by a succession of support elements (2, 22, 24,  
25, 11) serving to support the web, said support elements  
having their surface qualities so selected as to make the  
adherence of the web at the cross-over point of said sup-  
25 port elements stronger to the downstream next, receiving  
support element than to the upstream preceding, deliver-  
ing support element.

30 48. Assembly according to claim 47, characterized -  
i z e d in that the surface of the delivering element is  
more hydrophilic than the surface of the receiving  
element.

35 49. Assembly according to claim 47, characterized -  
i z e d in that the surface of the delivering element  
(24) has a coarser texture than that of the surface of  
the receiving element (25).

50. Assembly according to claim 47, characterized in that the surface of the delivering element (24) is softer than the surface of the receiving element 5 (25).

51. Assembly according to claim 47, 48 or 49, in which system said web treatment device is a film-transfer coater, characterized by

10 - a support wire (2) of the dryer serving to pass the web (1) to a first support element (22) on which the web (1) is transferred onto the surface of a first film-transfer applicator roll (24),

15 - a second film-transfer applicator roll (25) serving to receive the web which has been transferred and supported by the surface of the first film-transfer applicator roll (24), and

20 - a next downstream located, contacting support element (11) serving to receive the web (1) which has been transferred and supported by the surface of the second film-transfer applicator roll (25).

25 52. Assembly according to claim 30 or 47, characterized in that the web is supported by means of a movable element that can be, e.g., a metal, polymer, glass fiber or carbon fiber belt, wire, felt or web or 30 band.

[57] **Abstract**

Method and assembly for supporting a web (1) during the postprocessing of a web of paper or board, in which method the web is passed from a preceding device to at least one next downstream located web treatment device (4) wherein to at least one side of the web (1) is applied a treatment agent causing wetting of said side of said web, and the web (1) exiting said web treatment device is passed to at least one dryer means (8). The web (1) is contactingly supported in a continuous and unbroken manner at least from said web treatment device (4) to said dryer means (8). Advantageously, the web (1) is dried by means of at least one dryer (3) before taking the web to the web treatment device (4), and the web is contactingly supported in a continuous and unbroken manner at least from said dryer means (3) preceding said web treatment device (4) to said dryer means (8) located downstream next to said web treatment device.

(Fig. 1)

1/3

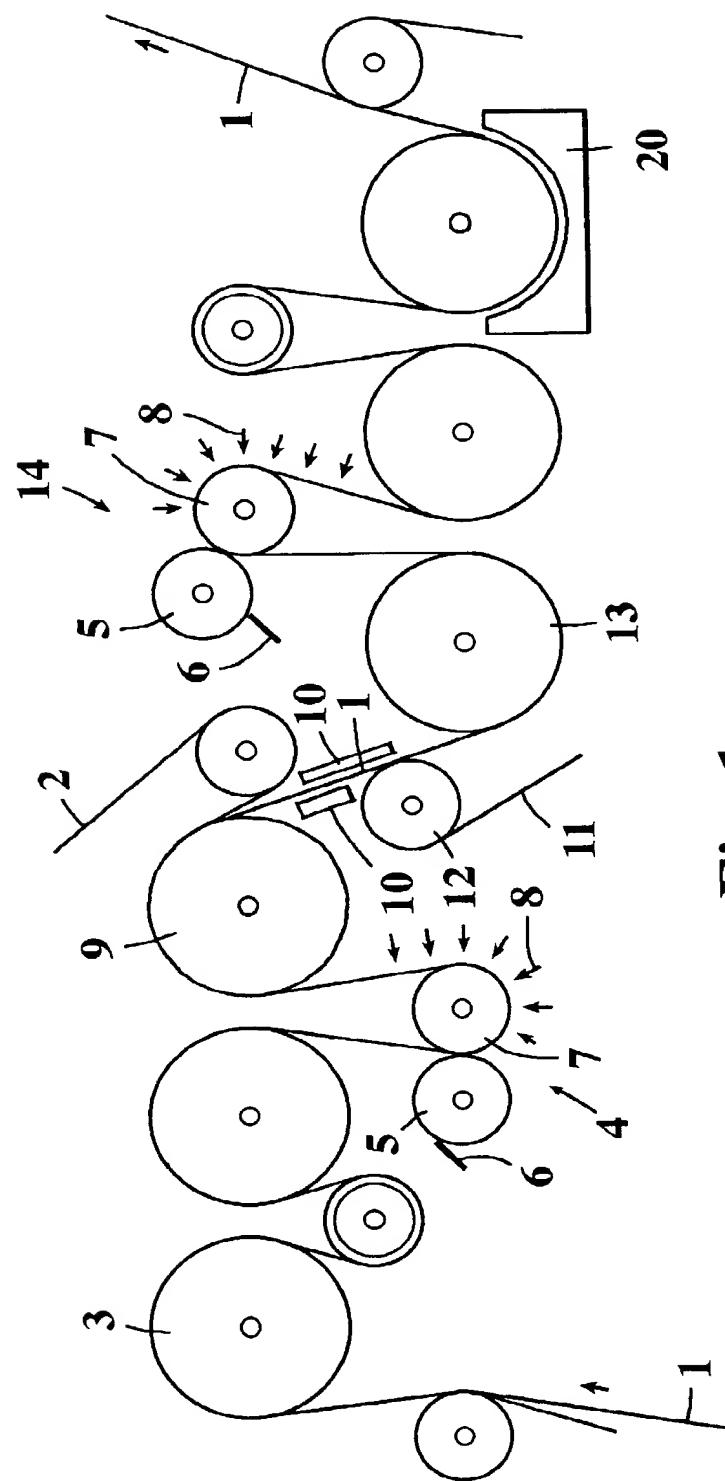


Fig. 1

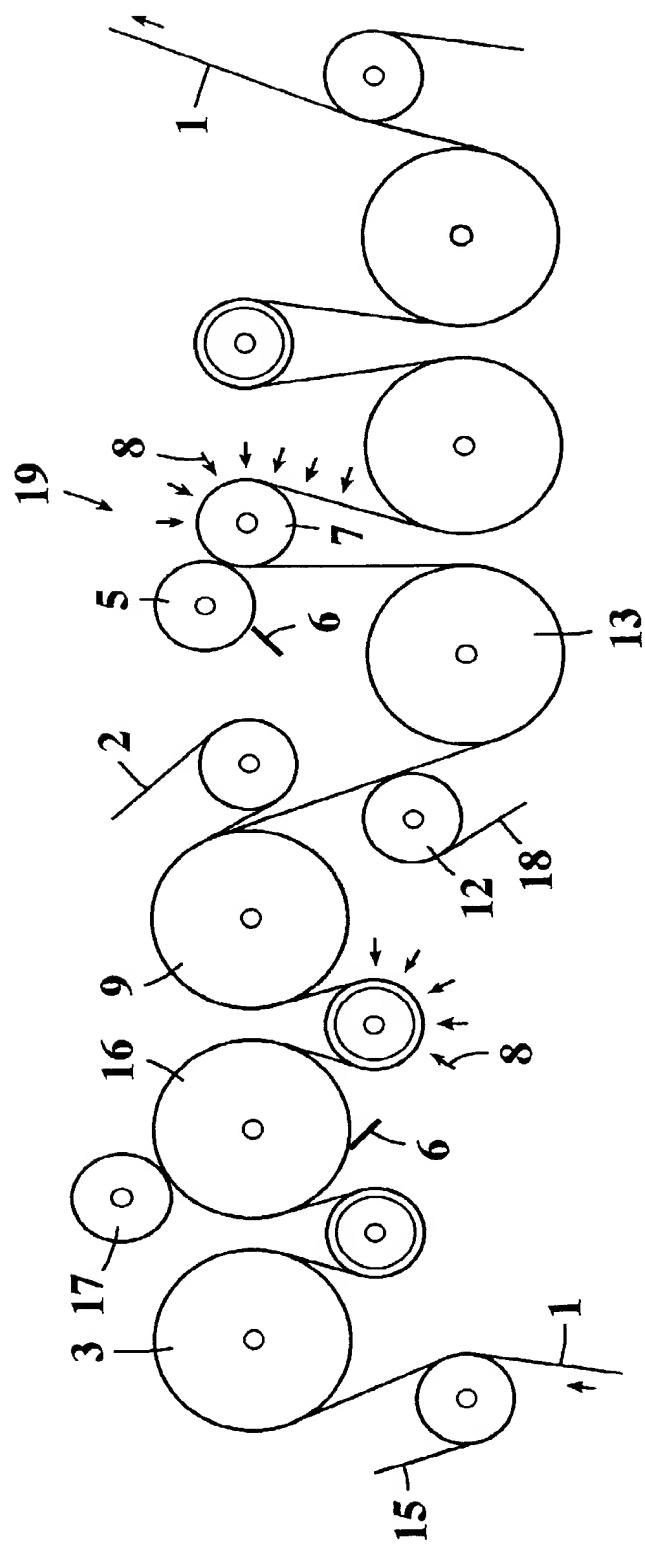


Fig. 2

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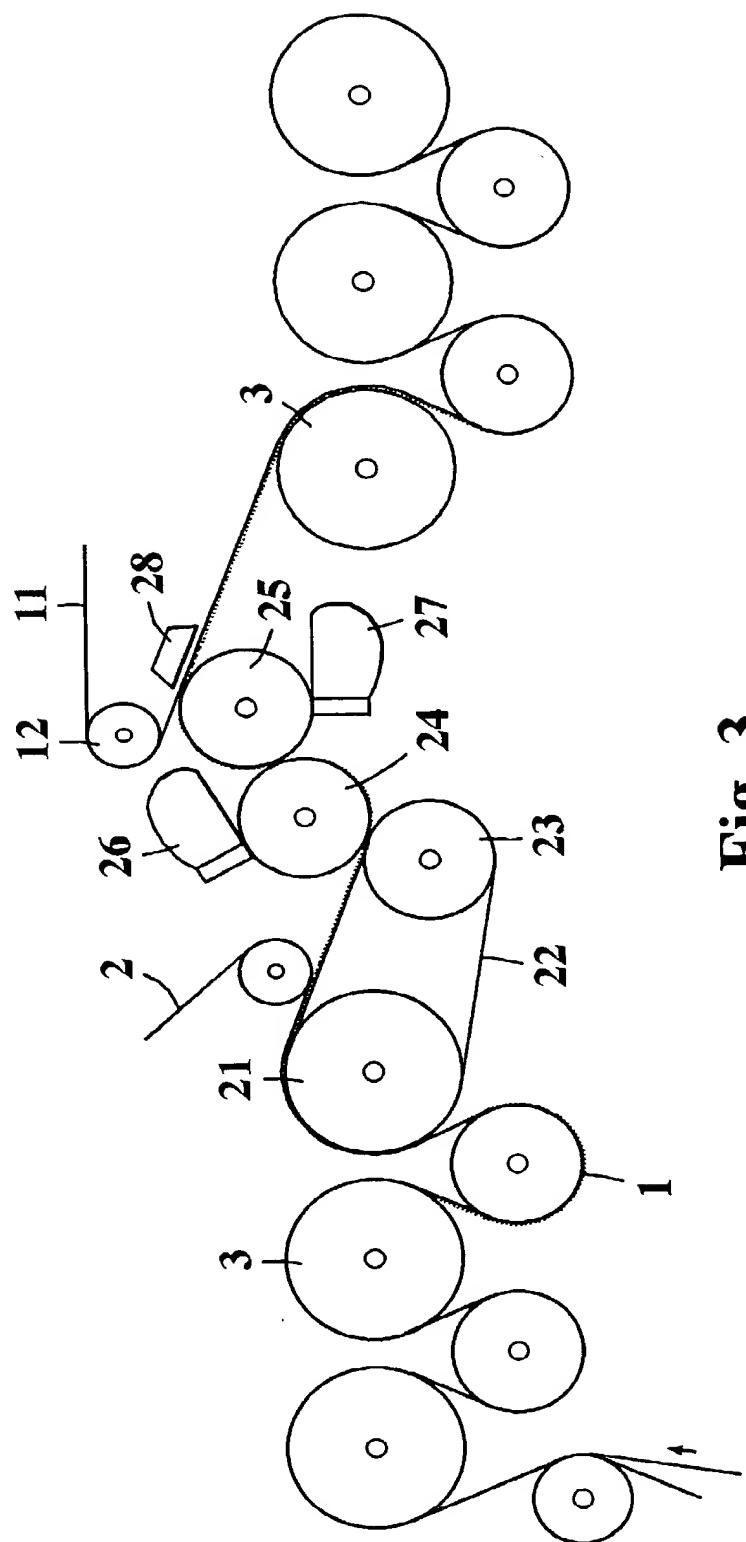


Fig. 3

**COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY**  
Includes Reference to PCT International Applications

Attorney's Docket No. \_\_\_\_\_

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: Method and assembly for supporting a paper and board web in finishing equipment

the specification of which (check only one item below)

is attached hereto

was filed as United States application

Serial No. \_\_\_\_\_

on \_\_\_\_\_

and was amended

on \_\_\_\_\_ (if applicable).

was filed as PCT international application

Number \_\_\_\_\_ PCT/FT00/00008

on \_\_\_\_\_ January 5, 2000

and was amended under PCT Article 19

on \_\_\_\_\_ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of the application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

**PRIOR FOREIGN/PCT APPLICATIONS AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:**

Country (if PCT, indicate "PCT")	Application Number	Date of Filing (day, month, year)	Priority Claimed Under 35 U.S.C. 119	
Finland	990008	5 January 1999	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO
PCT	PCT/FT00/00008	5 January 2000	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO
			<input type="checkbox"/> YES	<input type="checkbox"/> NO
			<input type="checkbox"/> YES	<input type="checkbox"/> NO
			<input type="checkbox"/> YES	<input type="checkbox"/> NO

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Continued) Includes Reference to PCT International Applications		Attorney's Docket No.
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I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120:

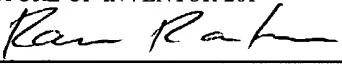
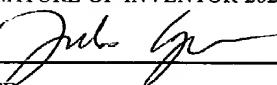
U.S. APPLICATIONS		STATUS (check one)		
U.S. APPLICATION NUMBER	U.S. FILING DATE	PATENTED	PENDING	ABANDONED
PCT APPLICATIONS DESIGNATING THE U.S.				
PCT APPLICATION NO.	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED (if any)		
PCT/FI00/00008	5 January 2000			

**POWER OF ATTORNEY:** As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith (*List name and registration number*)

MYRON COHEN, Reg. No. 17,358; THOMAS C. PONTANI, Reg. No. 29,763; LANCE J. LIEBERMAN, Reg. No. 28,437; MARTIN B. PAVANE, Reg. No. 28,337; MICHAEL C. STUART, Reg. No. 35,698; KLAUS P. STOFFEL, Reg. No. 31,668; EDWARD M. WEISZ, Reg. No. 37,257; CHI K. ENG, Reg. No. 38,870; JULIA S. KIM, Reg. No. 36,567; VINCENT M. FAZZARI, Reg. No. 26,879; ALFRED W. FROEBRICH, Reg. No. 38,887; ~~37,897~~; ANDRES N. MADRID, Reg. No. 40,710.

Send correspondence to:			
<u>Michael C. Stuart</u> <u>Reg. No. 35,698</u> <u>Cohen, Pontani, Lieberman &amp; Pavane</u> <u>551 Fifth Avenue, Suite 1210</u> <u>New York, New York 10176</u>		Direct Telephone calls to: (name and telephone number)  <u>Michael C. Stuart</u> <u>(212) 687-2770</u>	
1	FULL NAME OF INVENTOR	FAMILY NAME <u>Rantanen</u>	FIRST GIVEN NAME <u>Rauno</u>
2	RESIDENCE & CITIZENSHIP	CITY <u>Karlstad</u>	STATE OR FOREIGN COUNTRY <u>Sweden</u> <u>SE</u>
1	POST OFFICE ADDRESS	POST OFFICE ADDRESS <u>Frödingshöjd 23</u>	CITY <u>65637 Karlstad</u>
2	FULL NAME OF INVENTOR	FAMILY NAME <u>Lipponen</u>	FIRST GIVEN NAME <u>Juha</u>
2	RESIDENCE & CITIZENSHIP	CITY <u>Kerava</u>	STATE OR FOREIGN COUNTRY <u>Finland</u> <u>FI</u>
2	POST OFFICE ADDRESS	POST OFFICE ADDRESS <u>Sarvimäentie 8 L 158</u>	STATE & ZIP CODE/COUNTRY <u>FIN-04200 Kerava</u>

Combined Declaration for Patent Application and Power of Attorney (Continued) (Includes Reference to PCT International Applications)				Attorney's Docket No.
2 0 3	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY
2 0 4	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY
2 0 5	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY
2 0 6	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY
2 0 7	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY
2 0 8	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY
2 0 9	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY

Combined Declaration for Patent Application and Power of Attorney (Continued) (Includes Reference to PCT International Applications)				Attorney's Docket No.
2 1 0	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY
2 1 1	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
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	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY
<p>I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.</p>				
SIGNATURE OF INVENTOR 201 	SIGNATURE OF INVENTOR 202 	SIGNATURE OF INVENTOR 203		
DATE July 23, 2001	DATE July 23, 2001	DATE		
SIGNATURE OF INVENTOR 204	SIGNATURE OF INVENTOR 205	SIGNATURE OF INVENTOR 206		
DATE	DATE	DATE		
SIGNATURE OF INVENTOR 207	SIGNATURE OF INVENTOR 208	SIGNATURE OF INVENTOR 209		
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